



Transmission intensity and drug resistance in malaria population dynamics: Implications for climate change

Author(s): Artzy-Randrup Y, Alonso D, Pascual M
Year: 2010
Journal: PLoS One. 5 (10): e13588

Abstract:

Although the spread of drug resistance and the influence of climate change on malaria are most often considered separately, these factors have the potential to interact through altered levels of transmission intensity. The influence of transmission intensity on the evolution of drug resistance has been addressed in theoretical studies from a population genetics' perspective; less is known however on how epidemiological dynamics at the population level modulates this influence. We ask from a theoretical perspective, whether population dynamics can explain non-trivial, non-monotonic, patterns of treatment failure with transmission intensity, and, if so, under what conditions. We then address the implications of warmer temperatures in an East African highland, where, as in other similar regions at the altitudinal edge of malaria's distribution, there has been a pronounced increase of cases from the 1970s to the 1990s. Our theoretical analyses, with a transmission model that includes different levels of immunity, demonstrate that an increase in transmission beyond a threshold can lead to a decrease in drug resistance, as previously shown, but that a second threshold may occur and lead to the re-establishment of drug resistance. Estimates of the increase in transmission intensity from the 1970s to the 1990s for the Kenyan time series, obtained by fitting the two-stage version of the model with an explicit representation of vector dynamics, suggest that warmer temperatures are likely to have moved the system towards the first threshold, and in so doing, to have promoted the faster spread of drug resistance. Climate change and drug resistance can interact and need not be considered as alternative explanations for trends in disease incidence in this region. Non-monotonic patterns of treatment failure with transmission intensity similar to those described as the 'valley phenomenon' for Uganda can result from epidemiological dynamics but under poorly understood assumptions.

Source: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2965653>

Resource Description

Early Warning System:

resource focus on systems used to warn populations of high temperatures, extreme weather, or other elements of climate change to prevent harm to health

A focus of content

Exposure :

weather or climate related pathway by which climate change affects health

Climate Change and Human Health Literature Portal

Ecosystem Changes, Temperature

Temperature: Fluctuations

Geographic Feature: 

resource focuses on specific type of geography

Other Geographical Feature

Other Geographical Feature : highlands

Geographic Location: 

resource focuses on specific location

Non-United States

Non-United States: Africa

African Region/Country: African Country

Other African Country: Uganda; Kenya

Health Impact: 

specification of health effect or disease related to climate change exposure

Infectious Disease

Infectious Disease: Vectorborne Disease

Vectorborne Disease: Mosquito-borne Disease

Mosquito-borne Disease: Malaria

Mitigation/Adaptation: 

mitigation or adaptation strategy is a focus of resource

Adaptation

Model/Methodology: 

type of model used or methodology development is a focus of resource

Outcome Change Prediction

Resource Type: 

format or standard characteristic of resource

Research Article

Timescale: 

time period studied

Short-Term (

Vulnerability/Impact Assessment: 

Climate Change and Human Health Literature Portal

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content